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DEPARTMENT OF EDUCATION

PROVINCE OF ALBERTA

COURSE OUTLINES
FOR
SENIOR HIGH SCHOOL SCIENCE

Including SCIENCE 10, SCIENCE 12, SCIENCE 20
CHEMISTRY 30 and PHYSICS 30

September 1961

This outline will replace those published a year ago entitled Course Outline for Science 10 and 20, and Revised Outlines for Chemistry 30 and Physics 30. It is to be used for the School year 1961-62.

Main Objectives for Courses in Science

Students should:

1. acquire facts, principles, concepts, and appreciations in order to better understand and interpret their environment.
2. acquire some competence in critical thinking and the methods of science.
3. develop a scientific attitude.
4. gain some skill in the reading of and the analysis of current articles on scientific subjects.

SCIENCE 10

The prescribed text for Grade X is *Introductory Chemistry and Physics* by Pickard and Radomsky. Students in Grade X who are not on the text rental plan, will be expected to purchase the text.

The course outline sets out a logical arrangement of the concepts and must be followed (Section I, Section II, then Section III) because of the large number of students who transfer during the year. For large schools where the number of classes make it desirable to offer both the chemistry and physics simultaneously to different classes, transfer presents no problem.

More detailed information is included in the *Early Warning Announcement* distributed by the Department of Education in June, 1960.

The course consists of three sections.

SECTION I — INTRODUCTION TO SCIENCE

Unit 1 — SHORT HISTORY OF SCIENCE

Chapter 1. Our Debt to the Past

Unit 2 — MATTER

Chapter 2. Matter — Its Classification

Chapter 3. Matter — Its Composition

Chapter 4. Matter — Its Structure

SECTION II — INTRODUCTION TO CHEMISTRY

Unit 3 — LANGUAGE OF CHEMISTRY

Chapter 5. Symbols and Formulae, The Shorthand of Chemistry

Chapter 6. Equations — Short Stories of Reactions

Unit 4 — FOUR IMPORTANT SUBSTANCES

Chapter 7. Oxygen — Our Most Abundant Element

Chapter 8 — Hydrochloric Acid — A Typical Acid

Chapter 9. Sodium Hydroxide — A Typical Base

Chapter 10. Sodium Chloride — A Typical Salt

SECTION III — INTRODUCTION TO PHYSICS

Unit 5 — MECHANICS OF FLUIDS

Note: Most of this unit is optional, that is, Chapters 11 to 15. However, in Chapter 13 the section on the Expansion of Gases (Boyle's Law) and also Experiment 13 in Chapter 15 are required for study. It is suggested that this material be covered in conjunction with Chapter 19.

Unit 6 — HEAT

Chapter 16. Heat and Temperature
Chapter 17. Expansion of Solids
Chapter 18. Expansion of Liquids
Chapter 19. Expansion of Gases
Chapter 20. Specific Heat and Thermal Capacity
Chapter 21. Latent Heat
Chapter 22. Experiments on Heat

Unit 7 — SOUND

Chapter 23. Production, Propagation and Velocity of Sound
Chapter 24. Transmission of Sound
Chapter 25. Distinguishing Features of Sound
Chapter 26. Resonance: Sympathetic Vibration
Chapter 27. Laws of Stretched Strings
Chapter 28. Experiments on Sound

Experimental work is to be considered an integral part of the course. Students should spend one day per week in the laboratory. The choice of experiments is left entirely with the teacher. Not all experiments can be covered therefore it is important to exercise care in the selection of those to be done. Matriculation students are expected to do the majority of exercises and problems at the end of each chapter.

SCIENCE 12 (interim)

Introduction

It seems reasonable that all students should have an opportunity to gain some knowledge of the field of science, but all students do not have the ability nor the desire to follow a matriculation program of studies in science. The Alberta Royal Commission on Education expressed, in recommendation 69, the need for a survey-type course in physical science for students attempting a non-matriculation program. These students would be, in many cases, those who attain a low standing in science on the Grade IX Departmental Examination. The course in Science 12 could be an introduction to Science 10 or it could be terminal in nature. In Science 12 the appropriate treatment of the subject matter would have, no doubt, a greater emphasis on experimental work and would be less mathematical than the approach in Science 10.

The Science 12 text is *Physical Science for Canadian High Schools,* by Hogg, Cross and Little.

The course consists of four units:

Unit I. A. The Nature of Things, to include chapters:

3. Atoms and Molecules
4. Molecules in Motion
5. Air, an Important Mixture
6. Water, an Important Compound
7. Water for Machines

B. The Chemical Nature of Things, to include chapters:

53. Chemical Activity
54. The Shorthand of Chemistry
55. What are Ions?

Unit II. A. The Earth, to include chapters:

8. The Earth and its Motions
9. Rocks of the Earth
10. The Changing Earth
11. The Record of Rocks
12. Life in Earth History

B. The Universe, to include chapters:

58. The Sun
59. The Sun's Family
60. Comets, Meteors and the Moon
61. Beyond the Solar System

Unit III. Fire and Fuels, to include chapters:

22. What is Fire?
23. Oxidation
24. Fires and Explosions
25. The Control of Fire
26. Oil and its Origin
27. Coal and its Origin
28. Fuel Gases
29. The Carbon Dioxide Cycle

Unit IV. Weather, to include chapters:

18. Winds and Air Masses
19. Fronts and Storms
20. Weather Forecasting
21. What is Climate?

No specific time distribution for the units is specified since it is expected that teachers should be free to expand or condense topics as they see fit to meet the needs and interests of the class. The inference is that experienced teachers should be in charge of such classes so that satisfactory adaptations of content and method can be made readily. Experimental work must be included in the program.

SCIENCE 20

The following outline is intended for all schools during 1961-62. The sequence of Physics then Chemistry is to be followed to avoid difficulty of student transfer during the school year.

The texts for the Physics-Chemistry (Science 20) are as follows:

1. *Physics for Secondary Schools*, Alberta Edition: Eubank, Ramsay, Rickard.
2. *Chemistry for Secondary Schools*, Advanced Edition: Croal, et al.

All students should be requested to buy these two texts.

Laboratory experience should be provided. The teacher's reference for this work is *Experiments in Laboratory Chemistry*, Couke, Croal, Louden (Copp Clarke).

The course consists of a physics section and a chemistry section as outlined below:

A. PHYSICS SECTION

1. MECHANICS

Suggested time — 2 months

Chapters 1. Introduction
2. Measurement
3. Density and Specific Gravity
4. Buoyancy
5. Force, Work and Power
6. Experiments on Mechanics

2. LIGHT

Suggested time — 2 months

Chapters 7. Nature and Propagation of Light
8. Photometry

9. **Reflection of Light — Mirror**
10. **Refraction of Light — Lenses**
11. **Colour**
12. **Optical Instruments (Optional)**
13. **Experiments on Light**
14. **Modern Developments in Physics (Optional)**

Experimental work is to be considered an integral part of the course. Students should spend at least one day a week in the laboratory. All problems at the end of each chapter should be done by the students.

B. CHEMISTRY SECTION (*Chemistry for Secondary Schools,* Advanced Edition: Croal, et al).

Suggested time — 4 months.

Note concerning laboratory work: Some teachers have found difficulty in supplying laboratory exercises to cover the Chemistry of Science 20. Course material for demonstrations as well as class experiments in this section of the work may be found in *Experiments in Laboratory Chemistry,* by Couke, Croal, Louden, published by Copp Clarke, Toronto. The cost of this text is about $2.00. Problems involving precentage composition, weight to weight, weight to volume and volume to volume relationships should be stressed.

UNIT I. **Review of Science 10, Chemistry Section** — Much of this review of Science 10 will be incidental and used throughout the course to introduce new work. However, as a general introduction certain terms should be discussed and definitions established. These terms should include: element, compound, atom, molecule, atomic and molecular weights. The four main types of chemical reactions should be reviewed as well as the method of writing and balancing equations.

UNIT II. **Naming Compounds** — In addition to the study of the system used in naming compounds this should include practice in the writing of formulae. Pages 139 - 146.

UNIT III. **Mathematics of Chemistry**

Review of percentage composition.
Review of Weight to Weight problems, pages 147, 148, Questions page 151.
The Gas Laws (Review of Science 10 Physics) pages 89 - 99.

Gay-Lussac's Law of Volumes and Gram Molecular Relationships of Weight to Volume in Gases, pages 105 - 106, Questions page 152.

Calculations involving the finding of simple and true formulae from percentage composition of a compound, pages 119 - 123.

Unit IV. **Ionization**

Study of the terms referring to water and solution, pages 56 - 80.
Study of ionization, pages 153 - 163.
Include: Electrolysis of water. Acids, Bases, Salts, Neutralization, (review plus ionization characteristics).

HYDROLYSIS

Unit V. **The Periodic Classification of the Elements**

The Periodic Table, pages 234 - 239. This study should include the relationship between the atomic structure of the elements and the table. Review pages 133 - 138 and the table found in the front-end paper.

Application of the Periodic Table as seen in two families of elements.

a. The Halogens

1. Atomic structure — see front-end paper.
2. Comparison of properties of chlorine (page 221), bromine (page 228) and iodine (page 230).

b. The Alkali Family

1. Atomic structure —see front-end paper.
2. Properties, pages 240 - 241.

Unit VI. (Optional)

Two Gases
Hydrogen, pages 42 - 55.
Nitrogen and the Atmosphere, pages 33 - 41.

CHEMISTRY 30

Information on Course Content and Laboratory Exercices

1. AUTHORIZED TEXT

Chemistry for Secondary Schools, Advanced Edition: Croal et al.

2. COURSE CONTENT

The course consists of chapters 10 - 15 (review) and chapters 16 - 33 (new material). Owing to the length of the course chapters 24, 25 and 26 are to be considered as material for reading and additional study if time permits. These chapters are NOT included in the work that will be covered in the Departmental Examinations.

Chapters 10 - 15 have been included in order to provide for the necessary review of the fundamental mathematics of chemistry. It is suggested that no longer than four (4) weeks be used for this review.

3. DEMONSTRATIONS AND EXPERIMENTS

The revised laboratory manual consists of twenty laboratory exercises, eleven of which include demonstration material. Students will be expected to perform not fewer than fourteen laboratory exercises, including the obligatory exercises. 1, 2, 3, 4, 7, 13, 17, 18, 20, 23, 24 (**1958 Laboratory Exercises in Chemistry 30**). Additional experimental material may be found in **Experiments in Laboratory Chemistry** referred to in Science 20.

4. EQUIPMENT

A list of equipment, needed for the prescribed experiments, is contained in **Laboratory Exercises.**

PHYSICS 30

Information on Course Content and Laboratory Exercises

Elementary Physics, Littler

2. COURSE CONTENT

(a) The content selected from the text consists of materials on three topics: Mechanics, Heat and Electricity.

(b) The following portions of the text are used:

1. **Mechanics:** Chapters 1 - 9 inclusive.
2. **Heat:** Chapters 13 - 18 inclusive, and Chapter 21.

LABORATORY EQUIPMENT FOR SCIENCE

Student Experimental Work

It is suggested that students should work in groups of two. Each group should be equipped with the following apparatus. This apparatus should be stored at the laboratory station at which the group works. (Prices quoted are approximate.)

CHEMISTRY EQUIPMENT SCIENCE 10

APPARATUS (for a group of 2)	UNIT PRICE	TOTAL
Beakers {2 150-ml. capacity	$ .40	$ .80
{1 250-ml. capacity	.40	.40
1 mortar and pestle (small size)	.55	.55
1 Florence flask (500 cc)	.70	.70
1 deflagrating spoon	.20	.20
1 doz. test tubes (medium size, Pyrex)	.08	1.00
2 test tube clamps	.15	.30
3 crucibles and covers (size '0')	.70	2.10
2 4" square wire gauze (asbestos)	.15	.30
1 crucible tongs	.50	.50
2 evaporating dishes	.30	.60
1 Bunsen burner	1.60	1.60
1 Erlenmeyer flask (500 ml.)	.40	.40
2 rubber tube clamps	.20	.40
1 graduated cylinder (50 ml.)	1.50	1.50
1 test tube brush	.50	.50
1 set of ring stand and rings	5.00	5.00
1 funnel (small)	.50	.50
2 utility clamps	1.20	2.40
1 wire triangle (clay guards)	.25	.25
3 wide mouth gas bottles	.45	1.35
1 4" triangular file	.30	.30
1 wing top for Bunsen burner	.30	.30
1 spatula (small)	1.00	1.00
1 asbestos mat (12" square)	1.00	1.00
1 thermometer (--20 to 110° C)	2.50	2.50
1 pneumatic trough	1.10	1.10
6 reagent bottles (4 oz. size -- named for chemical reagents, glass stoppers)	.50	3.00
		$30.55

For a group of 20 students $ 305.50.
There will, however, be some discounts due to quantity buying, case lots, etc.

REAGENTS AND MATERIALS REQUIRED (based on a group of 20 students)

	QUANTITY	COST
Alcohol, Methyl (local purchase)	1 gal.	$ 3.50
Aluminum, sheet	1 sq. ft. 1/32" thick	2.00
Ammonium Hydroxide	4 lbs.	2.70
Barium Chloride, xtals CP.	1 lb.	1.45
Barium Chloride, Tech.	1 lb.	1.10
Calcium Carbonate (marble chips)	5 lbs.	3.05
Calcium Chloride, Gran. USP.	5 lbs.	6.00
Copper, sheet (for strips)	1 lb. 1/32" thick	3.55
Copper Sulphate, xtals CP.	1 lb.	2.25
Cupric Chloride, anhydrous	¼ lb.	2.70
Hydrochloric Acid, concentrated Sp.G.1.19	6 lbs.	3.45
Iron filings	1 lb.	1.15
Iron nails (obtain locally)		
Lead, sheet	1 sq. ft. 1/16" thick	2.10
Lemon juice (local purchase)		
Litmus	4 ozs.	2.95
Manganese Dioxide CP.	3 lbs.	12.00
Magnesium ribbon	1 oz.	1.90
Mercuric Oxide CP.	¼ lb.	5.55
Methyl Orange	1 oz.	1.35
Nitric Acid USP.	7 lbs.	4.32
Phenolphthalein	4 ozs.	1.90
Potassium Chloride	1 lb.	1.55
Potassium Chlorate CP.	2 lbs.	6.00
Salt (not iodized) Granular USP.		4.50
Sand (local purchase)	5 lbs.	
Silver Nitrate	4 ozs.	4.00
Sodium Hydroxide, pellets USP.	1 lb.	1.05
Sodium, metal	¼ lb.	1.70
Sodium Sulphate, xtals CP.	1 lb.	1.60
Solder, spool (local purchase)		.50
Sugar, cubes (local purchase)		.25
Sulphur (flowers of S.) powdered	1 lb.	1.50
Sulphuric Acid, SP.G.1.83	9 lbs.	4.50
Vinegar (local purchase)		
Zinc (Mossy) (low in As, Fe and Pb)	1 lb.	10.80
		$ 102.92

CP--Highest degree of purity. USP--Less pure. Tech--Contains some impurities.

PHYSICS EQUIPMENT SCIENCE 10

MINIMUM APPARATUS FOR A CLASS OF 20 - 24 STUDENTS

(Listed prices are approximate)

	Unit Cost	Total Cost
1 Brownian movement apparatus		$ 3.75
* 1 setof Pascal Vases with base attachment		28.75
1 set of capillary tubes		1.80
1 barometer		13.50
* 1 set of Magdeburg hemispheres		7.50
1 exhaust pump with base and bell jar		75.00
1 Torricellian tube		.85
1 open tube manometer (mounted)		4.00
1 closed-tube manometer		1.50
1 Bourdon pressure gauge		3.75
1 lift pump model		1.85
1 Boyle's Law apparatus		13.50
1 Venturi tube		
12 thistle tubes per doz.		2.64
3 balance scales --(Harvard Trip)	$16.00	48.00
3 sets of weights	15.00	45.00
5 glass U-tubes	.50	2.50
5 lb. bottle methyl alcohol		2.85
5 lb. bottle carbon tetrachloride		2.55
5 lbs. mercury		21.00
5 thermometers (centigrade) each	1.65	8.25
5 calorimeters	3.00	15.00
2 coefficient of linear expansion apparatus with spherometer and rods	15.00	30.00
2 adhesion disks	.70	1.40
1 adjustable thermostat		3.00
4 dilatometers	2.50	10.00
1 ball and ring (hand form)		1.75
1 bi-metalic strip		.60
2 Charles' Law tubes (Waterman form)	1.75	3.50
2 boilers or steam generators	6.15	12.30
2 sets specific heat specimens	.75	1.50
4 water traps (for heat of vaporization)	.50	2.00
4 meter sticks	.45	1.80
24 beakers		
glass tubing		
rubber delivery tube		
rubber stoppers (6 lb. assorted)		

	Unit Cost	Total Cost
4 graduated cylinders 100 cc	$2.25	$ 9.00
2 glass tube cutters	.85	1.70
retort stands		
clamps and rings		
12 Bunsen burners or propane burners	1.15	13.80
2 sets of tuning forks (unmounted)	3.75	7.50
1 set of tuning forks (mounted)		30.00
2 rubber hammers	.60	1.70
* 1 Kundt's tube		14.75
* 1 pint cork dust		.25
1 steel rod		1.00
1 brass rod		1.50
1 coil spring (longitudinal vibrators)		2.65
1 electric bell in vacuo		8.50
1 rotator (hand driven, worm drive)		24.00
1 Savart's toothed wheels		5.65
1 Crova's disc		1.25
1 combined siren and color disc		2.90
1 sonometer with strings of varied densities and diameters		41.75
1 set of collision balls		4.00
2 sets of resonance tubes	7.00	14.00

* optional equipment

3. **Electricity:** Chapters 33, 34, 36 up to and including "Solenoid", 37, 38 and 39.

(c) In addition to the above, it will be very desirable to commence the course by teaching the Metric System of measurement. (See Experiment 1, *Laboratory Exercises.*)

3. DEMONSTRATIONS AND EXPERIMENTS

Both these devices should be regular procedures of teaching the course.

(a) Experiments:

The revised *Laboratory Exercises* consists of eighteen experiments (omit Nos. 7 and 8) from which students are expected to perform not fewer than fourteen (14). The fourteen or more experiments may be selected according to the type and quantity of equipment available. Not more than two (2) of the listed experiments may be omitted for each of the three topics.

Each of Experiments 1 - 11, inclusive, consists of two parts. In each case, PART B is stated as a follow-up problem to accompany PART A.

PART B is provided as extra work for the better students; its use is optional and at the discretion of the teacher.

(b) Demonstrations:

In addition to the experiments, described in *Laboratory Exercises,* the text provides ample suggestions for demonstrations.

4. EQUIPMENT

A list of specific equipment needed for the prescribed experiments is contained in *Laboratory Exercises.*

5. TEXT

The authorized text was selected because of its precise descriptive and quantitative treatments of the selected topics.

These qualities of precise statement and accurate calculation will become, it is hoped, specific objectives in the teaching of this course.

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